PEST TECHNOLOGY

PEST CONTROL AND PESTICIDES

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PEST TECHNOLOGY is published for the interest of everyone concerned in the control and prevention of all kinds of infestation in agriculture, marine and harbour installations, food manufacture and distribution, hospitals, and all kinds of domestic, commercial and industrial premises. It is read in more than seventy countries by agricultural merchants and millers, food suppliers, farmers, research institutions, shipping companies, port authorities, pest control officers, spraying contractors and medical authorities.

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RESEARCH AND EXPERIMENTS

A monthly digest of reports of significant trends and investigations in all fields of weed and pest control and wood preservation operations.

Potato Root Eelworm in Europe

PROGRESS IN THE CONTROL of potato root eelworm (*Heterodera rostochiensis* Woll.) is referred to in a report for the year 1960 just published on the subject by the European and Mediterranean Plant Protection Organisation.

Although some new pockets of infestation were discovered in regions previously free, e.g. in Austria, Iceland, Norway, Spain (the island of Tenerife), Switzerland and the USSR (one district in Byelorussia and one in Lithuania), there was no major change in the area of distribution of the pest. In the regions where infestation was known to occur, some local spread was recorded in Belgium, France, Guernsey, Jersey, the Netherlands and the USSR, but almost generally a decrease in the intensity of attacks was reported to have been obtained by crop rotation or other methods of control.

Increased interest is reported in the use of resistant potato varieties as a means of control, and no less than ten countries are engaged in work on this aspect of the problem. Very encouraging results on a practical level were obtained, for instance, in Western Germany and the Netherlands, but it is said that in some places in Eastern Germany difficulties were encountered with resistance breaking strains of the pest.

Discussing the application of direct chemical control, increasingly applied in some countries for valuable crops of first-earlies, good results were evidently obtained with Vapam (sodium N methyl dithiocarbamate), especially in Jersey and the USSR.

Weed Control in Carrots

AN INVESTIGATION of the effects on frame sown bunching carrots of chlorpropham on the one hand and of Shell W vapourising oil the present standard herbicide on the other has been carried out by the MAFF Stockbridge House Experimental Horticulture Station in Yorkshire.

The treatments consisted of (1) control; (2) chlorpropham at ½ lb./acre pre-emergence; (3) chlorpropham at 1 lb./acre pre-emergence; (4) chlorpropham at 2 lb./acre pre-emergence; (5) chlorpropham at ½ lb./acre post emergence; (6) chlorpropham at 1 lb./acre post emergence; and (7) Shell W vapourising oil at 60 gal./acre post emergence.

Each treatment was replicated twice. The seed was sown last year in a Dutch light frame on 17th February. The pre-emergence treatments were applied on 19th February. The Shell W was applied on 4th April when the carrot seedlings were at the first true leaf stage, the post emergence chlorpropham treatments being applied on 8th April.

A report of the tests which has recently been published by the station says that Shell W remained the most efficient herbicide. Of the chlorpropham treatments, those used pre-emergence were the most effective, though annual meadow grass *Poa annua*, and mayweeds *Matricaria* sp. were not controlled. Post emergence treatments of chlorpropham resulted in stunted growth and discoloured foliage and a poor crop of roots, while the weeds present were merely checked.

Surfactant Inhibits Plant Viruses

A SURFACTANT that has clear-cut antiviral activity in plants has been found in greenhouse tests by the United States Department of Agriculture.

Tests are now underway to find if the compound is useful as a preventive of virus introduction into plants by insects, a major factor in the spread of viruses.

The surfactant—dioctyl sodium sulfosuccinate (DOSS)—markedly reduced development of five virus diseases in bean plants. Surfactants, compounds which reduce the surface tension of liquids, are commonly added to agricultural chemicals to improve their contact with plant surfaces or to facilitate penetration.

DOSS is not a cure for plants with established virus diseases, because it is not absorbed or translocated in effective amounts. It does provide a valuable basis for further research on chemical control of viruses.

Effectiveness of DOSS in arresting virus development was found by plant pathologist I. R. Schneider and plant physiologist J. W. Mitchell in their search for surfactants to combine with antibiotics in the experimental control of virus diseases. However, in their work at the Beltsville Research Centre, they found that application of the surfactant alone to plant leaves 15 minutes, and in some cases up to 30 hours, after inoculation with viruses effectively inhibited disease development.

Paired leaves of pinto bean plants were inoculated by brushing leaf surfaces with extracts of virus-infected plant juice and an abrasive. An aqueous solution of DOSS, 2,000 p.p.m., was applied 15 minutes later to one leaf of each pair by mechanical spray or cotton swab. Treated leaves in each experiment developed fewer local lesions (visible disease sites) than did untreated leaves. Test viruses were southern bean mosaic, tobacco mosaic, and lucerne mosaic.

The compound was also highly effective in preventing development of systemic symptoms (reduction in plant growth) in Black Valentine beans and pinto beans caused, respectively, by tobacco ringspot and yellow bean mosaic viruses.

Although DOSS assists penetration of other chemicals into plants, the compound was not found to move into plants or to be translocated in effective amounts through leaves or roots. It apparently moved into plant cells, as did the viruses, through openings made by the inoculation procedure. Thus, it may be useful as a protection against insect-transmitted viruses, which

gain entry into plants through openings made by insects.

The U.S. scientists believe activity of DOSS may be two-fold, i.e., it destroys infectiousness of virus particles and interferes with initial virus multiplication.

In some experiments with southern bean mosaic virus, treatments were made 16 hours and 30 hours after inoculation. Lesions were smaller in treated leaves than in untreated leaves, even when no reduction in number of lesions occurred. This indicates that the amount of virus formed per infection site was reduced, although infection was not prevented.

Moreover, even when no visible lesions occurred, Schneider and Mitchell were able to recover some virus from treated, inoculated leaves five days later. Recovery of virus indicates that infection did take place but that virus multiplication did not proceed effectively enough to produce visible symptoms.

How DOSS is able to inhibit virus is not known, but its action is directly correlated with its ability to reduce surface tension of water. Four other compounds related to DOSS were also tested, and it was found that increasing ability to reduce surface tension of water paralled effectiveness in antiviral activity.

Fly Control Measures on Farms

DIBROM—administered in sprays or in sugar baits—are reported to have given successful fly control at several farms in California. At a stock farm and a cattle ranch, the spray consisted of an emulsion of 1½ oz. of Dibrom 8E concentrate to 2½ gal. of water, containing ¼ lb. of granulated sugar as an attractant. After livestock was removed from the barns, spray was applied thoroughly inside and out. An agitating tank hydraulic pump was used with a low pressure fogging nozzle. Particular care was taken under the eaves and around the window and door frames. The same spray was applied to all fences around the corrals, to all ground surfaces littered with animal feed, manure and other organic matter, and to all trees and shrubbery near the barns. When all areas were sprayed weekly, fly control (according to a report in the journal, *California Agriculture*) far surpassed that achieved by previous treatments with standard insecticides, and none of the animals near the areas being sprayed was affected.

In the dairy chosen for the test, spraying was avoided near lactating animals, and instead, dry sugar bait was prepared with one teaspoonful of Dibrom 8E concentrate and 1 lb. of granulated sugar, thoroughly shaken together. The bait was placed in large galvanised trays, which were positioned either on or just above the ground outside the milking barn and some inside the barn isolated from the milking areas. Each tray was baited with one tablespoonful of sugar-Dibrom mixture. After 24 hours, the trays were filled to overflowing with dead or near-dead flies, and uneaten bait and insecticide were evidently still effective after 28 days.

At the same farm, a wet bait was used made up of 1 lb. of granulated sugar and one teaspoonful of Dibrom 8E well mixed with a cup of water. This was just thick enough to be painted on to surfaces and trays with a brush, and can thus cover a greater area, but knock down was very rapid with wet and dry types of bait.

Dry Mix Timber Preservative

A NEW DRY MIX timber preservative, developed by the Division of Forest Products, is expected to find useful application in the New Guinea timber industry, according to an article in a recent issue of journal of the Australian C.S.I.R.O.

The division is reported to have developed a simple diffusion treatment whereby green timber is dipped into a concentrated preservative solution and stacked wet to allow the preservative to diffuse into the wood.

The new product is expected to be of particular use for building lumber in New Guinea and other tropical countries where some species cannot be satisfactorily treated by pressure impregnation. A patent application covering the new formulation has been lodged.

Anti-wood Borer Polish

WHAT IS THOUGHT to be an unprecedented step for the ecclesiastical authorities in Britain is to be seen in their virtual recommendation of a recently-developed wax polish for inhibiting attack by wood-boring insects in church buildings.

The polish, which has been developed by Mr. J. S. C. Dealey, of Ipswich, has been in the process of steady development for the past five years. The main test insect was *Lyctus brunneus*, in oak specimens, but *Anobium punctatum* and *Xestobium rufovillosum* were also used in other experiments. The final polish, now manufactured under the trade name of Prior Polish, was tested by the Central Council for the Care of Churches who are reported to have found that it lived up to its claims to prevent entry of any wood by larvae of woodborers. Provided the film of polish is undisturbed, it remains effective and—says Mr. Dealey—one spring-cleaning using the polish should give protection for the entire year.

The National Trust have also adopted the polish, having been given access to the council's test reports.

Now, the material has been recommended by name in Bishop's letters that are distributed with English parish magazines.

A small company (called Insect Control) has now been formed to market the polish, sales of which are to be directed at first at ecclesiastical and "stately home" markets, and it is to be on sale on the Continent later this year.

"Read the Label" Call in U.S.A.

AN INTENSIVE PROGRAMME for educating those who recommend, use and handle pesticide chemicals has been started by the State of Wisconsin (U.S.A.) department of agriculture. By means of special radio programmes and published newsletters, it is intended to emphasise the importance of a proper understanding of the safety factors connected with the recommended uses and the safe handling and storage of pesticides.

The entire programme is directed to over 7,000 agricultural authorities and distributors of pesticides, feeds, fertilisers and seeds.

In addition to featuring safe-use practices, the pesticide bulletins outline the enforcement policies of the state government, with the object of reminding those responsible of the laws governing pest control chemicals, and the need to read the label and other literature provided with all products.

The first issue of the bulletin was published in September and had short articles under the headings of "Dairy Farm Fly Control Pesticides", "Your Employees Also Need Pesticide Knowledge, Facts", "Don't Sell Unregistered Pesticides", "Pesticides and Seeds", etc.

Commenting on the launching of the campaign, the National Agricultural Chemicals Association's *News and Pesticides Review* says that this is one of many similar campaigns conducted by state authorities. " Positive action of this type is welcome," it says, "for it enhances and supports what the industry has been advocating for many years; it is hoped that other states will follow along and do likewise".

PRESERVATIVE TREATMENT OF EUCALYPT TELEGRAPH TIMBERS IN AUSTRALIA

By W. G. KEATING, A.R.M.T.C. (App. Sc.)*

A paper delivered by the author at the recent conference of the British Wood Preserving Association.

THE establishment in 1957 of a preservation plant capable of treating large numbers of poles by vacuum pressure methods, made available for the first time in Australia a facility that several countries have had for over fifty years. The reason for Australia's late entry into this field is due to the fact that until recent years supplies of naturally durable timbers with average lives of 20-25 years in the ground were available. Species such as the various ironbarks, tallow-wood (*Eucalyptus micrcorys*), white mahogany (*E. acmeniodes*), grey box (*E. hemiphloia*) and wandoo (*E. redunca*) have given excellent service as poles. As the availability of these and other durable species decreased it became necessary to use the medium and low durability timbers, supplies of which are comparatively good. However with the rising cost of pole renewals in the post-war years it soon became obvious that if poles of low durability must be used then some form of preservative treatment was required.

Experimental results with Poles

With the advent of treated poles the use of preservative treated crossarms became an economic proposition. Untreated crossarms had an average life in the order of 25 years which was quite satisfactory for use with untreated poles, but if the full advantages were to be gained from the use of treated timber an extension to this average life was required.

It was fortunate that the present difficult supply position was anticipated some 25-30 years ago by the Commonwealth Scientific and Industrial Research Organisation (C.S.I.R.O.) and the various pole using authorities. This foresight resulted in a considerable amount of preliminary work and investigation being carried out and field tests instigated. This work provided invaluable background for all who were interested in pole treatment and was, in fact, the basis for its introduction on a commercial scale.

The field tests referred to above were installed in five sites in New South Wales and Victoria, and consisted of several hundred poles (or pole stubs) treated by different methods and with a selection of preservatives that were available at the time of installation (1932-36).

In all, 179 poles were treated with creosote which has been the outstanding preservative of the test. At the last inspection (1958) only a small percentage are showing even slight sapwood deterioration below ground line and none has yet been condemned. The creosote treatments were either full length pressure or hot and cold open tank. A small sample of Ascu pressure treated poles have also given good results.

The test sites were chosen in areas where either a high decay or termite hazard was known to exist, and the species used were timbers of moderate to low natural durability.

Eucalyptus is by far the most important genus of Australian forest trees. Its members dominate 95 per cent of the forest area and spread out over much of the remainder of the country. About 600 species are recognised and out of these about sixty species have attained commercial importance. A wide variety of hardwood timber is produced from these species; timbers which display a considerable range in characteristics such as

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colour, weight, hardness, toughness, strength, durability and fissibility. Generally speaking, the characteristic differences in physical properties between eucalypts and most of the commonly used Northern Hemisphere timbers, both softwoods and hardwoods, are their greater strength and weight and higher shrinkage values.

The natural durability of the eucalypt species varies widely, a feature that is obvious on examination of the pole service records. Scattered throughout the Commonwealth the Australian Post Office has over 2 million poles, practically all eucalypts, in service with an annual usage of approximately 104,000 which covers replacement and new work. The average life of untreated eucalypt poles is approximately 22 years, with some examples of exceptionally long life (50-60 years especially in Queens land) and also very short life, 3-4 years in Tasmania.

The sapwood thickness of most of the commonly used eucalypt poles ranges from ½-1 in., although with one or two species the upper limit may be as high as 2-2½ in. Eucalypt sapwood permeability is such that pressures of about 200 lb./sq. in. are sufficient to affect complete penetration; however, there is little or no penetration in the heartwood which is extremely refractory. Although this zone of treated timber is narrow, provided that there is a creosote retention of approximately 10-15 lb./cu. ft. of sapwood the field tests described earlier indicate that the protection provided is satisfactory. With some of the denser species, i.e. those with air dry densities above 60 lb./cu. ft., some difficulty has been experienced in achieving retentions in excess of 11 lb./cu. ft. of sapwood.

The sapwood of many of the eucalypts is susceptible to attack by the powder-post borers of the Lyctus and Bostrychid species. While poles are air seasoning in preparation for treatment the damage caused by these insects can be serious, especially in warm climates, if no preventive action is taken. Sapwood decay is not normally a factor to be considered during the seasoning period provided correct seasoning principles are followed, although unseasonable conditions of high rainfall and humidity have occasionally produced evidence of this form of deterioration. Reference will be made later to the control measures that have been introduced to control these two factors.

Another characteristic of certain of the eucalypts is their tendency to split during seasoning. With some species the percentage of poles that are required to be cut back to a shorter length has sometimes reached 50 per cent during and just after a long hot summer. This is due to the fissile nature of some species aggravated by the release of growth stresses in fast grown trees and high shrinkage characteristics. In drying from green to 12 per cent moisture content the percentage shrinkage may be as high as 12 per cent in the tangential direction and 6 per cent in the radial direction. However, it has been proved that even extensive splits along the length of the pole have a negligible effect on strength.

Fig. 1. Spraying poles with BHC emulsion.

Fig. 2. Prefabricated pole prior to treatment.

Causes of pole failure

In Australia approximately 80 per cent of wooden pole replacement is due to decay, 14 per cent due to termites and 6 per cent for other reasons.

Although in terms of area termite activity is more widespread than the incidence of decay, the Australian population distribution is such that the majority of wooden poles in service are located in regions of moderate to high rainfall where fungal attack is common.

A large number of different species of termites are found in Australia and although the greatest development is found in the tropical and sub-tropical regions, damage to poles has occurred in varying degrees in all States except Tasmania. The soil dwelling subterranean species

is responsible for practically all the loss caused by this form of breakdown. The most important genus economically is *Coptotermes*. There are six species of this genus in Australia, four of which attack living trees as well as timber in service. The distribution range of Coptotermes covers practically the whole of mainland Australia. *Mastotermes darwiniensis* is another economically important species with greater powers of destruction than any other species, but fortunately its range of distribution is limited to areas north of the Tropic of Capricorn, a region of sparse settlement.

Other reasons for pole replacement would include obsolescence and top splitting.

Introduction of treated poles

The introduction of treated poles by the Australian Post Office followed the publication of a report written by a special committee appointed for the purpose of investigating all aspects of pole and crossarm usage within the Department. For the first time all the information concerning departmental procedure for purchasing, distribution, treatment, erection and inspection of poles was collated in one report. This very thorough enquiry brought to light many aspects of existing practices that could be improved upon and the urgent need to increase the life of wooden poles.

The Committee's main recommendation was that the use of full length pressure treated poles be adopted as policy. The savings possible by the introduction of treated poles were considerable due to five main reasons:

1. Increased life
2. Machine prefabrication
3. Decreased size
4. Bulk purchasing methods
5. Reduced maintenance charges.

Subsequent to the above report and after some further investigation, contracts were let in 1956 for the supply of poles from five proposed treatment plants. In this manner the Department fostered the introduction of the industry into Australia and has continued to give the lead in regard to pole and crossarm treatment. There are now twenty-six plants established throughout the country, with the biggest expansion taking place in the waterborne treatment of plantation grown softwood timber. Treated pole production for the Postmaster-General's Department is now in the order of 80,000 poles per annum, distributed from eight treatment centres.

Plant design and pole handling

For pole treatment, where the preservative is mainly creosote, plant design is more or less standard with facilities for Lowry and full-cell treatments. The normal cylinder size is a nominal 6 ft. internal diameter and 72 ft. in length. The quick locking door is usually of the type where the door rotates on a central supporting pivot to engage locking lugs. The door is sealed by hydraulic pressure on a rubber sealing ring set in the cylinder door flange. Earlier plants favoured heating coils of 2 in. pipe in the cylinder and creosote tanks, but later designs show a tendency to utilize the heat exchanger principle.

Fork lift handling is used at all pole plants except one where, due to space restrictions, overhead gantry cranes of 5 and 10 ton capacity are used.

Specifications

Before treatment commenced, two specifications were drawn up to cover the quality and preservative treatment of poles. These specifications were based on experimental work, similar specifications from overseas and a limited amount of actual experience in this field. Naturally once treatment was established, there were many modifications, mostly of a minor nature, that were found necessary. These specifications in their present form are not inflexible but are subject to constant examination with a view to simplifying the task of the contractor, while at the same time maintaining as high a standard as is practicable.

The following are brief comments concerning the main points covered by the two specifications:

1. *Species:* Naturally the main advantage to be gained from the introduction of treatment is an extension to the range of acceptable species. As a general rule those species in the moderate to low durability class now being treated are characterised by their symmetrical form and comparatively thick sapwood (1-1½ in.), both good features for a treated pole.

2. *Defects:* It is impracticable to specify poles absolutely free of all defects, but at the same time careful check is kept to prevent those poles with defects that would nullify the benefits of treatment being accepted. Any defect that is likely to cause untreated timber to be exposed at a later date or that cannot be rectified by treatment is regarded as dangerous.

3. *Shape and Dimensions:* Poles must be reasonably straight both from an aesthetic viewpoint and for ease of prefabrication.

Minimum ground line dimensions are specified for the various pole lengths and some attempt has been made to relate pole size to species strength. It is anticipated that in the near future information will be available to enable this realationship to be made more accurate.

4. *Seasoning:* The current practice in Australia is that all poles are air seasoned until such time that the sapwood moisture content is below 25 per cent. The specification stipulates a number of conditions relating to the method of construction of stacks, etc. Seasoning periods may vary from three to eight months, depending on species and climatic conditions.

Moderate splitting and checking is permissible during

the seasoning period, but rejection of poles for this reason is still high. End coatings are used.

5. *Borers:* The extent of sapwood borer attack is limited. It was not anticipated that this would be a major cause of pole rejection in the time available for infestation, but when large quantities of poles with a high sapwood starch content, such as spotted gum (*Eucalyptus maculata*) were stacked in a confined space, the borer population, mainly Bostrychids, rapidly reached plague proportions and considerable damage was done. This problem has now been overcome, by regular spraying with a benzene hexachloride emulsion using a portable petrol driven spray unit. Spraying with a sodium pentachlorphenate-borax solution to prevent decay is also carried out when necessary. See Fig. 1.

6. *Prefabrication:* Poles are prefabricated after seasoning and before treatment. See Fig. 2. An identification disc is inserted at a point 10 ft. from the butt.

7. *Preservative:* Creosote which must conform with Australian Specification No. K55-1936 "Coal Tar Creosote for the Preservation of Timber" is the usual preservative specified.

Australian creosotes are largely obtained from vertical retort coal tar which results in appreciable differences in the constituents and the specific gravity when compared with European or American types. However, indications are that the end results are similar.

At one plant due to its remoteness from sources of creosote supply, a waterborne salt of the copper-chrome-arsenic type is being used. This has provided the opportunity to study the performance of this type of preservative with eucalypts. To date approximately 17,000 poles have been treated in this manner and it seems that fears regarding the lack of weathering protection may not be realised.

8. *Retention and Penetration:* The minimum specified retention is 12 lb. of creosote or 1.3 lb. of dry salt per cubic foot of sapwood. The penetration of the preservative must be for the full depth of the sapwood or 1 in., whichever is the least.

9. *Cleanliness:* Poles must be reasonable clean before despatch. For creosoted poles this may involve a holding period of several weeks or else a final steaming followed by a comparatively short holding time.

Treatment and retention

The Lowry process is generally used and a typical treatment schedule would be to fill at atmospheric pressure, and then maintain preservative at a pressure of 200 lb./sq. in. at a temperature of 180-200°F. for a period of 1½-3 hours. Empty and draw a final vacuum of at least 26 ins. of mercury for ½ to 1 hour.

When difficulty was first experienced with the treatment of some of the denser species, a changeover was made to the full-cell process in order to obtain the desired minimum retention of 12 lb./cu. ft. of sapwood. However, it was found that poles took so long to dry off after treatment that serious supply difficulties were encountered and it was decided to revert to the Lowry process and treat to absolute refusal. Post-treatment was not possible due to the formation of sludge with the particular creosote used at this plant. This resulted in minimum retentions of approximately 11 lb./cu. ft. of sapwood.

On the other hand, it has sometimes proved difficult to keep the retentions in some of the more permeable species, when very dry, within reasonable limits without reducing the pressure period below a point necessary to ensure adequate penetration and distribution of the preservative. Existing plants, treating eucalypts, are not equipped for Rueping treatments, but it is possible that one or more will make the necessary adjustments.

A limited amount of investigation has been carried out in order to determine the distribution of retentions between individual poles in a single charge by means of

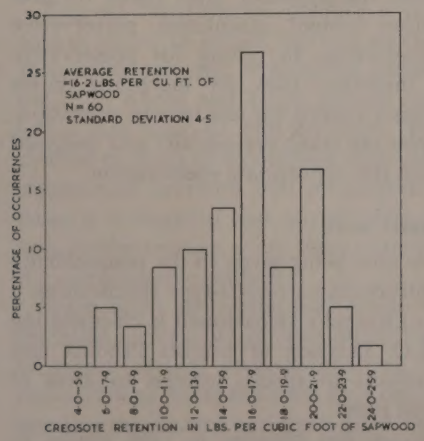

Fig. 3. Retention rate of creosote in sapwood.

Fig. 4. Untreated test pole of narrow-leaved ironbark (Euc. crebra) *eaten out in two years by* Mastotermes darwiniensis.

weighing. The distribution has usually followed the normally expected pattern, although the standard deviation has been larger than was anticipated. Fig. 3 shows the results obtained from one such weighing and although this would be regarded as a good treatment when considering gauge readings, it can be seen that there is a significant percentage below 10 lb. of creosote per cubic foot of sapwood. It is planned to investigate this aspect further. Only those species with similar treatment characteristics are included in the same charge.

Throughout this paper retentions are stated in pounds per cubic foot of sapwood. This is general practice in Australia and specifications are usually written in this manner, the reason for this being that in order to ensure that adequate protection is provided to this relatively narrow but variable treated zone, it is essential to know that all the sapwood is treated and that the required loading of preservative is retained in it. This has the disadvantage that it is usually necessary to calculate the sapwood volume for each individual pole, a tedious operation. However, from the mass of statistical data accumulated it has been possible with some species to determine a relationship between sapwood volume and total volume.

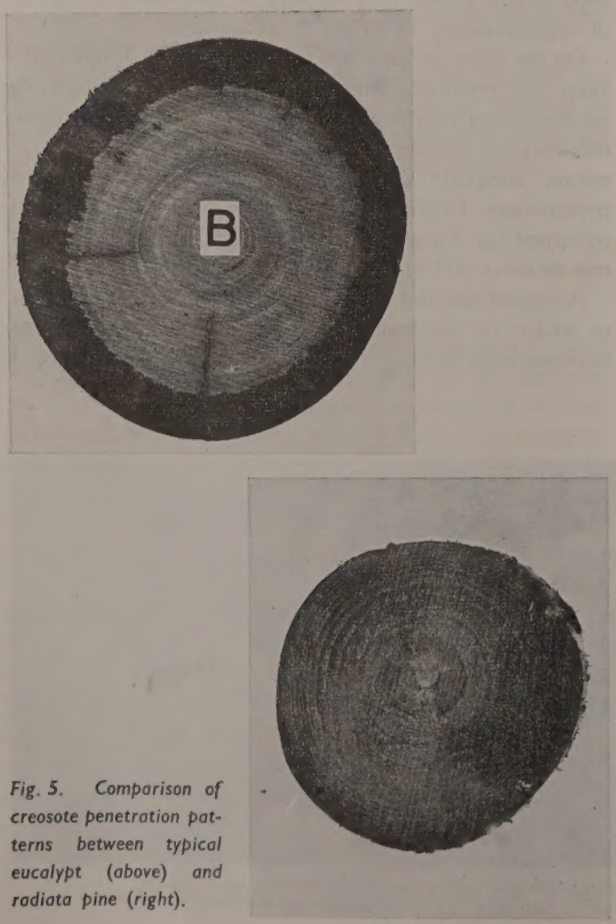

Fig. 5. Comparison of creosote penetration patterns between typical eucalypt (above) and radiata pine (right).

With some of the light-coloured eucalypts, the estimation of sapwood thickness by eye can be difficult and the use of an indicator has been found necessary. One that has proved quite successful is dimethyl yellow which has a pH range of approximately 3-5. A solution of 1 gram in 500 ccs. of alcohol sprayed on a freshly cut surface turns the heartwood red and the sapwood yellow.

Naturally moisture content has an important influence on retention and a close check is kept on poles coming forward for treatment. Moisture content measurements are made by inserting a V-shaped electrode between two nails driven into the pole about $1\frac{1}{4}$ in. apart to a depth of approximately three-quarters of the sapwood thickness. Incipient decay has occasionally occurred in sapwood resulting in an excessive rise in moisture content after even a light shower of rain. At two plants trials with stack covers have proved most successful.

One aspect that has caused some concern is the apparent streaky penetration obtained with some species. When an increment boring, taken from one of these species, is split longitudinally and examined, the penetration pattern is often a series of alternate black and white lines. On closer examination it can be seen that the vessels are penetrated with creosote but not the fibres; whether this is serious or not has yet to be decided. Work at the C.S.I.R.O. Division of Forest Products has indicated that all penetration in eucalypts occurs from the end grain along the vessels.

Inspection procedure

Resident inspectors are stationed at each plant. Poles are inspected three times in their progress through the plant. Firstly, the green pole is inspected for such defects as decay, termites, borers, grub holes, broken or undersized sapwood, large splits or knots and excessive sweep or crook. After seasoning, inspection would be concerned with bad splitting or borer attack that may have developed. Final inspection takes place after treatment.

Besides the above the inspector must check on prefabrication, moisture content, cleanliness, preservative retention and penetration. In testing for preservative penetration the inspector uses an increment borer attached to an impact wrench for less tedious operation. Preservative samples are taken periodically and analysed for conformity with the appropriate specification.

Current experimental work

Consideration is now being given to the practicability or otherwise of introducing a results-type specification.

The Postmaster-General's Department is co-operating with the C.S.I.R.O. Division of Forests Product and others in two projects of special interest to users of preservative treated poles.

One is a graveyard test installed in 1958 similar to those described earlier, but using those preservatives in

common use throughout the world at present. The location of this test is in North Queensland in two areas where damage caused by the activities of the termite *Mastotermes darwiniensis* is common. The first inspection in 1960 showed that the treated poles were still sound, but that two controls of narrow-leaved red ironbark (*Eucalyptus crebra*) had been destroyed (see Fig. 4). This species would be expected to have a service life of at least 20 years in areas free of Mastotermes.

The other project is an investigation to determine the effect of a number of preservative treatments on the strength of poles. This work is part of a much broader project to obtain data on the strength of full sized poles of various species. Included in the test are two artificial seasoning processes often used in conjunction with preservative treatment. It is hoped that one of these, viz. Boultonizing, may have an application for those species that split badly during air-seasoning.

Radiata pine poles

During the past 40-50 years exotic softwood plantations have been established in many parts of Australia, the total acreage now exceeding $\frac{1}{2}$ million acres. The main species is radiata pine (*Pinus radiata*) a timber that is very readily treated with preservatives, 100 per cent penetration being obtained with normal pole sizes. Fig. 5 shows a comparison between the penetration obtained with a typical eucalypt and radiata pine.

Consideration is now being given to the possibility of using this species in those areas where plantations are established and the eucalypt pole supply does not meet the demand. One such locality is South Australia where steel poles are normally used.

Maintenance treatments

There are still over 2 million untreated wooden telephone poles in service in Australia and consequently maintenance treatments of these poles in order to prolong their life is an important factor.

Current departmental practice is to open up the soil to a depth of 18 inches, clearing away all decayed wood then either spraying or brushing creosote on to the pole for 18 in. above and below ground line. The back filled soil is then puddled with creosote. The efficiency of this method depends on a complete removal of decayed wood, injection of creosote into all pockets and a dry pole. Also, it is essential that retreatments should be carried out, on the average, every three years except maybe with the more durable timbers.

Some other pole-using authorities, and in particular the State Electricity Commission of Victoria, use a form of treatment that involves charring the pole with an oxy-acetylene flame followed by a creosote spray. Treatment of this nature has given good results both in field trials and in service.

Other maintenance treatments are being investigated and consideration will be given to those methods that are applicable for use with pressure treated poles.

Treatment of crossarms

In May 1960 the first commercial high pressure (1,000 lb./sq. in.) treatment plant in the world commenced operations. This plant was developed and established as a result of the Postmaster-General's Department requesting quotations for the supply of a substantial quantity of pre-bored pressure treated crossarms. The necessity to specify preservative treatment for crossarms was due to two reasons: (i) the increasing shortage of durable timbers of the quality desired, and (ii) the need to extend the service life of crossarms to approximately equal the expected life of the recently introduced treated poles.

An Australian wide survey to determine the causes of crossarm failure made by the Division of Forest Products revealed that a large percentage of crossarms fail through splitting, a feature that had previously been noted in a survey of rail sleeper failure. This result pointed to the necessity of incorporating in the preservative treatment decided upon some form of weathering protection.

The treatment of eucalypt heartwood at pressures in the order of 200 lb./sq. in. achieves negligible or very slight preservative penetration, except maybe in some specimens of extremely dry, low density material. With a narrow sapwood band, sawn timber obtained from eucalypts contains none or at the most very little sapwood so that when consideration was being given to the treatment of crossarms, some modification to the usually accepted method of treatment was necessary. Research at the Division of Forest Products showed that a satisfactory treatment could be achieved using pressures in the order of 1000 lb./sq. in. Even at these high pressures complete penetration is not possible but from the information available at present the envelope pattern obtained should give a satisfactory life.

This experimental work showed that provided certain conditions of temperature and pressure were maintained and that the timber was at a satisfactory moisture content, no distortion of any consequence, due to the high pressure, was evident. This is not so with some of the impermeable softwoods such as spruce and douglas fir where severe distortion and collapse was evident at pressures above 300 lb./sq. in.

Preservative used

It was decided that it would be preferable to use a heavy oil in order to give the maximum resistance to weathering. Accordingly, the specified preservative was a 3 per cent solution of pentachlorophenol in furnace oil. The oil used is based on the American Wood Preservers Association Specification, P9-58.

Crossarms presented for treatment must be of first quality timber free of all but minor defects, seasoned, branded and bored. The dimensions of the most common type of arm used are 9 ft. in length of nominal 3 × 3 in. cross-section with either eight or fourteen 1 $\frac{1}{16}$ in. diameter spindle holes plus a central bolt hole.

The retention specified is 5 lb. 1 cu. ft. No penetration requirement is stipulated at present, although it is probable that once the treatment has settled down that a clause covering this aspect will be inserted in the specification.

Requirements concerning cleanliness of the treated crossarms are difficult to write into a specification and the final decision must be left to the inspecting officer, which is not a very satisfactory arrangement. However, crossarms must be reasonably clean before dispatch otherwise they are unpleasant to handle and could be dangerous to work on due to their slippery nature.

Commercial experience

The first and so far only high pressure plant is situated at Pemberton in the extreme south-west corner of Western Australia. This location is the centre of the large karri forest. Karri (*Eucalyptus diversicolor*) is a tree of magnificent form and impressive size, with straight boles of over 120 ft. free of limbs in abundance. The timber is reddish-brown in colour, uncommonly free of defects, moderately heavy (58 lb./cu. ft. at 12 per cent moisture content), hard and stronger than jarrah (*E. marginata*). Large quantities have been used in Australia and in many overseas countries, including the United Kingdom, for wharf and bridge timbers, mine guides, wagon scantlings and crossarms. Karri, however, has two disadvantages which must be recognised: (i) it is not durable in the ground, and (ii) it has a high shrinkage (10 per cent tangential, 4½ per cent radial).

Neither of these, however, need preclude the use of karri, provided appropriate allowances are made. At this treatment plant karri is the sole species treated.

The treatment cylinder is 20 ft. in length by 4 ft. 3 in. diameter, giving a capacity of approximately 300 nine foot crossarms per change. The cylinder is connected to a heat exchanger and circulating pump both of which are subjected to the full working pressure of 1,000 lb./sq. in. during the pressure phase. The door of the cylinder is held by two yokes which are opened and closed by hydraulic rams and is sealed by a chevron seal operated by a separate hydraulic system.

The autoclave is constructed of 1$\frac{7}{8}$ in. thick steel. The performance of the plant is most satisfactory, particularly the speed of operation, rate of heating and general flexibility.

The usual treatment cycle is 1 hr. pressure at 1,000 lb./sq. in. at 160°F. followed by a short vacuum and steam stripping to give as clean an arm as possible. A final vacuum is drawn before the door is opened. This schedule produces retentions varying from 5.0 to 6.0 lb./cu. ft.

Shortly after treatment commenced, two problems were evident. One was distortion due to further drying taking place during the treatment cycle and the other was the cleanliness of the treated crossarms. The distortion that occurred resulted in a substantial percentage of crossarms being rejected for excessive diamonding, undersize, twist, bow and splitting, all typical seasoning defects. The specification limits on moisture content stipulated only that the outer $\frac{3}{4}$ in. of the crossarm should be below 25 per cent. The contractor lacking any definite information to the contrary commenced treatment when this condition was attained. Trials with kiln dried crossarms soon showed that pretreatment moisture content was most important. After many more experiments, including minor changes in the treatment schedule, it was found that the optimum moisture content conditions were 18-20 per cent for the outer case and less than 30 per cent for the core. Once this was established, crossarms were given a final kiln drying treatment as it was impossible to obtain the required moisture content at Pemberton during the winter months by air seasoning. This did not reduce by much the overall rejection figure for, as previously mentioned, karri has high shrinkage values, but it did mean that although more arms were rejected prior to treatment fewer were rejected afterwards which is more favourable than the reverse situation.

A considerable amount of experimental work has been carried out by the Division of Forest Products and is still continuing in order to determine the optimum drying schedule for reducing distortion and improving retention, as it has been shown that if a fast schedule is used preservative retention increases.

After treatment crossarms are stripped out for drying. When production first started, it was found that the cleanliness of the crossarms was deteriorating, especially during wet weather, rather than improving. Analysis of the oil samples showed that the water content of the treating solution was too high and that an emulsion was being formed. This was due mainly to the fact that after the steaming process the mixture of condensate and oil was returned to a tank where after a settling period, water was run off from the bottom and what was thought to be solely oil returned to the system. However, analysis showed that in fact an oil-water mixture was being returned. As a result of the information the contents of the settling tank are now dumped and considerable improvement has resulted, but this problem has not been solved completely. For instance, previously dry crossarms in the centres of tightly bound bundles have exuded preservative when transported long distance in steel rail trucks, especially during hot weather.

APPLICATION OF ORGANIC PHOSPHOROUS INSECTICIDES FOR LIVESTOCK PESTS

By E. C. TURNER, Jr.*

This is the second of two articles dealing with the control of livestock pests by organic phosphorous insecticides. This part is concerned with the various methods of application that have been investigated and used.

The extremely efficient insecticidal activity of the chlorinated hydrocarbon insecticides has made possible an important new method of application of insecticides to range cattle. Utilizing the tendency for cattle to rub on objects in the field, Rogoff and Moxin[51] devised what we now call the cable type backrubbers. These self-applicating devices when treated with certain chlorinated hydrocarbon insecticides diluted in fuel oil give excellent control of horn flies on cattle. They have advantages in requiring much less time and labour and also less insecticide residue is found in animals utilizing backrubbers than in sprayed animals. The successful use of backrubbers against horn flies was quickly confirmed by numerous workers[52,53]. In addition, it was discovered that this method of application resulted in control of cattle lice[54].

The excellent results using chlorinated hydrocarbon insecticides in backrubbers was the probable reason that the organic phosphate insecticides were not extensively evaluated. Goodwin[55] reported 99.6 per cent control of horn flies with 5 per cent malathion in fuel oil on a backrubber. Hargett and Turner[56] also obtained satisfactory control of these pests using 1 per cent Bayer 21/199 dust in a modification of the oil type backrubbers. Excellent control of horn flies using 1 per cent ronnel in fuel oil has recently been reported[57,58]. It was also found that Bayer 21/199 (0.25 per cent oil solution) resulted in favourable control of horn flies.

Probably the use of organic phosphorous compounds on backrubbers for control of horn flies and cattle lice will continue to be somewhat limited due to their cost and other factors. In cases where resistance is a problem the situation could change. McDuffie[1] stated that there were empirical indications that horn fly resistance could occur; however, there has been no known case of insecticide resistance in this insect. On the other hand, several cases of resistance in cattle lice have been reported.

Litter dusters in poultry

Another method of insecticide application utilizing a natural habit of an animal has occurred in the development of the use of self-treatment dust baths and litter baths in the control of poultry ectoparasites. By the incorporation of an insecticide dust into dust bath boxes, the chickens treat themselves thus utilizing their habit of fluffing themselves in dust when given the opportunity. Creighton *et al.*[59] using sulphur dusts on chickens by this method obtained reduction of several species of poultry lice. Reinfestation occurred when the treatment was stopped. Other workers[60] obtained similar results.

The effectiveness of malathion as a general insecticide for the control of mites and lice of poultry led workers[61] to incorporate this insecticide either in dust box baths or in the litter for control of chicken body lice, *Menacanthus stramineus* (Nitz.). No lice were found for 70 days after application of 2 per cent malathion to the floor litter at the rate of 1 pound per 2 square feet. When dust bath boxes were used incorporating 4 per cent malathion, control of this insect was obtained for more than 35 days. Later, these same workers[62] in evaluating this method against other species of chicken lice obtained excellent control of each of five species of lice either occurring singly or in mixed populations.

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Residual fumigation

Most entomolgists have experienced the situation when a room in which test insects are being reared becomes contaminated with a small amount of an organic insecticide sitting on a shelf or behind a door. The havoc that follows makes one wonder if insects are really as hard to control as field results usually indicate. The high vapour pressure of several of the organic phosphorous insecticides has led workers to believe that insects in a closed building might be controlled by the presence of an insecticide vapour in rather small quantities. Fay and Lindquist[63] reported that parathion and diazinon possessed pronounced fumigant action against house flies. Later, other entomologists[64,65] found that diazinon applied as residual sprays for the control of house flies resulted in complete kill of horn flies on cows being brought into these barns for milking and feeding. This effect was reported to last for as long as two months. Turner and Hargett[66] further found that ronnel and Bayer 21/199 also exhibited this fumigant action but not as long as diazinon. They concluded that the period of effectiveness could be increased by decreased ventilation of the barn during the time the cows are in the pasture.

This method of insect control is now being given serious consideration by public health and quarantine officials[67] as a relatively safe method of ridding buildings and transportation vehicles of dangerous insects.

Animal systemic insecticides

The development of animal systemic insecticides for control of external and internal parasites of livestock has been one of the most important and exciting discoveries in entomology. The application of a chemical to an animal that would act as a systemic toxicant against its parasites has long been the aim of livestock entomologists particularly in the case of myiasis producing insects such as cattle grubs, *Hypoderma sp.*

The requirements that must be met in order to develop a truly successful insecticide have been formidable. First the material has to be highly effective as a systemic against the parasites but at the same time safe to use on animals of all ages and types. Radeleff and Woodard[68] stated that there should be a 10-to-1 margin of safety between the pest and the host. The dosage should be effective without ill-effect on the most susceptible animal even under such stress as that found in simultaneous operations such as dehorning, vaccination or castration. Second, the material must be practical and safe in the hands of the every-day farmer. Third, the material should not result in a build-up of chemical residue in the tissues of treated animals. Fourth, it should be inexpensive enough for general acceptance among farmers and stockmen.

The idea of a systemic insecticide is not new. Knipling[69] in 1938 used an internal application of phenolthiazine for control of the horn fly by rendering the manure of the treated animals toxic to the horn fly larvae. Bruce[70] also tried this with dosages of zinc oxide. True systemic action was accomplished by Lindquist *et al.*[71] when DDT and pyrethrum extracts were given to rabbits in large enough dosages to render their blood toxic to bedbugs. Other investigators obtained similar results using gamma BHC and other chlorinated hydrocarbon insecticides. These entomologists have been particularly interested in obtaining a systemic insecticide for control of cattle grubs. The chlorinated hydrocarbon materials were, however, found to be rather toxic to warm blooded animals and they were found to be stored in the tissues of treated animals [72,73,74].

Research was then turned towards the evaluation of organic phosphorous compounds as systemic poisons. McGregor *et al.*[75] reported on some early attempts to control cattle grubs systemically. Diazinon, applied orally at the rates of 5 to 50 mg. per kg., gave complete kill of the grubs present at the time of treatment and also of all those appearing for the next 2 weeks. Bayer L13/59 oral dosage (100 mg./kg.) also resulted in excellent kill of the grubs for two weeks after treatment. Bayer 21/199 at 25 mg./kg. was ineffective. Researchers[76,77] then tried some of these compounds externally on animals as sprays and washes. In general they found that 0.5 to 1 per cent Bayer 21/199 resulted in excellent control of cattle grubs present in the backs of the animals. Bayer L13/59 was less effective at the same dilution. It was considered that this control was as much by contact as by systemic action. Later, however, Brundrett *et. al.*[78] found that Bayer 21/199 applied to cattle as a 0.75 per cent spray killed cattle grubs before they appeared in the backs of the animals. Thus true systemic action was obtained by external application. This work was confirmed by several workers[79,80,81].

Control of cattle grub

Meanwhile, with the aid of screening techniques described by McGregor and Bushland[82] many chemical compounds were evaluated as possible animal systemics. In 1956, Dr. A. W. Lindquist[83] presented the results showing that ronnel, then known as Dow ET-57, acted as a systemic insecticide in the control of cattle grub. These results showed that the insecticide applied orally to cattle at the rate of 100 mg./kg., successfully prevented the appearance of cattle grubs in the backs of treated cattle. This activity was quickly confirmed by workers throughout the U.S.A.[84,85,86,87].

In 1958, Hewitt *et. al.*[88] described another chemical called American Cyanamid 12,880 or dimethoate

[O,O-dimethyl S-(N-ethyl=carbamoylmethyl) phosphoro=dithioate]. This chemical showed some promise in control of third instar cattle grubs when applied orally at the rate of 5 to 10 mg./kg. In field tests, however, Turner and Gaines[81] found that this material resulted in only about 70 per cent reduction in the number of cattle grubs appearing in the backs of cattle. These results were similar to those obtained by Neel[89] and later confirmed by Drummond[90]. It thus appeared that this material was effective at dosages only slightly below the toxic level for animals.

Also in 1958, another chemical called Dowco 109 or Narlene (O-4-tert-butyl-2-chlorophenyl O-methyl phosphoramido=thioate) was released for experimental evaluation. As shown by a number of workers[81,89,91,92], this compound was highly effective as a systemic insecticide against cattle grubs. In addition this compound was found to be somewhat unusual in that it was effective applied both internally as a drench or bolus or applied as a dilute spray. It is probable that this compound would have been developed further; however, its oxygen analog was found to be somewhat more effective and could be formulated easier. This material, called Ruelene [O-4-tert-butyl-2-chlorophenyl O-methyl methylphosphoramidate] was first made available to research workers in the spring of 1959. McGregor *et. al.*[93] in preliminary tests with this material applied Ruelene: (1) as a single oral treatment; (2) as multiple treatments in feed, and (3) as spray treatments. They found that the spray applications of Ruelene (0.25 to 1 per cent) resulted in excellent grub control as did the multiple treatments in feed. The single oral treatments did not appear to be as effective. Swanson and Collier[94], however, obtained somewhat more effective control of the grubs using the single oral dosage method. The high effectiveness of this material when applied as an external spray led to the development of the localized "pour-on" method of application in which a small amount of Ruelene was simply poured on the back of an animal in a highly concentrated solution. This was first described by Rogoff[95]. The effectiveness of this method was confirmed by Ioset and Ludwig[96].

The insecticide Bayer L13/59 has been evaluated as a systemic insecticide against cattle grubs in recent years. It did not seem to be as promising a systemic as Bayer 21/199 in early testing[76]; however, at somewhat higher dosages the material showed some excellent systemic activity against 3rd instar cattle grub larvae[75]. Its activity against first and second instar larvae was tested by Rosenberger[97]. The results indicated that the migrating first instar larvae could be killed within the body of the animal. This test was confirmed a year later[98]. In addition, Bayer L13/59 was found to exhibit excellent systemic activity against cattle grubs as a 2 per cent spray[99]. Present indications are that this material, though neglected initially by many research entomologist, will become an excellent systemic insecticide against cattle grubs and other pests of livestock.

Low level feeding

In an effort to make the orally applied systemic insecticides more convenient and acceptable, investigators began experiments incorporating these materials in the feed of animals. The idea was to apply the materials at very low levels over a period of several days or weeks. Thus, the objective was to allow enough insecticide to be taken in the animal to kill the insect but not enough to harm the animal. A thorough knowledge of the toxicity of the insecticide was most important.

The incorporation of ronnel in cattle feed for control of cattle grubs has been investigated numerous times[100-103]. These tests have shown that cattle grubs can be controlled by the administration of the insecticide in small daily doses over a period of 2 to 4 weeks. Longer periods of time did not appear to be practical since the daily dosage rate had to be above 6 mg./kg. per day.

A rather interesting use of ronnel in feed for the control of external parasites was reported recently. It has been well known that control of rats generally involved preliminary treatment of infested areas with a residual insecticide to control the flea vectors of disease. Bennington[104] demonstrated that the incorporation of ronnel with the anti-coagulant bait resulted in control of the rat fleas before the rats died (in a feeding period of 5 or more days).

To date ronnel, dimethoate, Dowco 109 ruelene and Bayer L13/59 have been investigated using this method of administration. The inability to control adequately the daily maximum dosage plus the inherent toxicity of these compounds has caused entomologists to hesitate in recommending this method of application for general use. It is generally concluded that more complete investigations must be made before the low level feeding of insecticides can be used extensively.

Use against other pests

By far the majority of publications on the use of systemic insecticides have been against cattle grubs; however, the use of these chemicals has resulted in outstanding control of a number of other insect pests of livestock. Theoretically all parasites feeding on the tissues of blood of livestock should be susceptible to control by one or more of the systemic insecticides. On a more practical level this has not yet appeared to be true especially when animals are continually subjected to reinfestation pressure. In spite of this, more and more

insect pests have been shown to be effectively controlled by these materials.

Peterson$_{105}$ reported that oral dosages of ronnel, at the rate of 100 mg./kg. resulted in excellent control of the first instar larvae of the sheep nose bot, *Oestrus ovis* L. Using Bayer L13/59 at the rate of 70 mg./kg., Chavarria and Carrillo$_{106}$ obtained 100 per cent effective control of this insect.

The so-called human bot fly, *Dermatobia hominis* (L. Jr.), a troublesome pest of cattle in Central and South America, has been found to be controlled by certain systemic insecticides. McGregor *et. al.*$_{107}$ reported that Dowco 109 (Narlene) applied orally in a single oral dose of 20 mg./kg. or applied externally as a 0.5 to 0.75 per cent spray would give economical control of this insect, Bolle$_{108}$ reported that Bayer L13/59, applied orally at the rate of 50 mg./kg. in feed or applied externally as a 0.6 to 1 per cent spray, resulted in complete kill of all skin larvae. Other workers$_{109}$ found that Ruelene applied either as a spray or oral drench would control this particular insect.

Systemic or contact?

As mentioned previously, certain of these materials are reported to be highly effective against screw worms and other blow flies. Whether this control should be called systemic or by contact poison would involve fine definition. Brundrett$_{45}$ found that Bayer 21/199 sprays (0.25 to 0.5 per cent) not only killed screw worm larvae already infesting animals but also acted to deter later attacks. This would indicate systemic action on the part of the insecticide. Marquardt$_{110}$ applied ronnel orally to sheep for control of fly strike and obtained effective control at the rate of 150 to 200 mg./kg. A 10 per cent oil smear of Bayer L13/59 was found to be effective against certain species of *Lucilia* by Seifert$_{41}$.

Against demodectic mange of dogs, ronnel has been reported to be quite effective. Veterinarians$_{111,112}$ stated that a combination of topical and oral medication was necessary for complete control.

These compounds and many others are presently being evaluated against other external parasites of animals and will be reported in later works. The majority of these new compounds are organophosphates. Thus it appears that even greater emphasis will be placed on the use of this particular group of compounds in the future. Dr. R. L. Metcalf, has summarized their impact upon basic and applied science. In a recent article$_{113}$, he states "few scientific discoveries have had as far reaching and dramatic consequences to our profession of entomology as the discovery of the biological activity of the pentavalentphosphorus atom, properly surrounded by lipophilic groups and possessing the requisite chemical instability".

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(*Cont. on page 43*)

CONTROL OF THE WHITE GARDEN SNAIL IN ISRAEL

By I. HARPAZ, M.Sc.(Agr.), Ph.D., F.R.E.S.* and Y. OSERI, M.Sc.,(Agr).*

Snails and slugs are serious crop pests. In Israel, the problem of the white garden snail has increased in recent years to disquieting proportions; this article describes experiments there in the application of Isolan for its control.

IN the spring of 1957, a series of preliminary experiments was carried out by Avidov in controlling white garden snails (*Theba pisana* Müller) injurious to citrus trees in Israel. The results of those trials were published[1] in the same year under the reservation that their conclusions were not final and that the tests should be repeated for confirmation. Nevertheless, it was apparent from Avidov's data that a high mortality of snails may be obtained by spraying with Isolan (1—isopropyl—3—methyl-pyrozolyl—5—dimethyl carbamate, made by J. R. Geigy SA, of Basle)[4]. This was actually observed for the first time by Pappas & Carman[6] in California in 1954 with regards to the European brown snail (*Helix aspersa* Müller). The latter species, however, occurs also in Israel[2], but not in such high numbers as to cause any noticeable damage.

Only after the completion of this work, did we learn that satisfactory results had been obtained in Southern California in controlling the European brown snail by cover sprays of Guthion and metaldehyde[7].

The experiments described below were designed in order to re-examine the efficacy of Isolan cover sprays, as compared to the common bran-metaldehyde bait. The use of metaldehyde for the control of snails in Israel is largely based on the thorough study by Cragg & Vincent[3] on the mode of action of this toxicant on terrestrial Gastropods, namely slugs, in England.

Based upon a survey of the injurious snail fauna of Israel[5], carried out during 1958–59, we selected the plots for the field trials in an area most heavily infested, and likewise timed the experiments for a period at which the snails were most active. Hence, our treatments were tried under the most difficult conditions for their performance. The field trials were preceded by a series of laboratory tests aimed at determining the concentration of Isolan to be used in the field.

TABLE 1

Mean percentage knock-down in laboratory tests

Isolan concentration	Knock-down percentage (hours after spraying)			
%	6	24	48	72
0.006	3.3	10.0	—	17.8
0.06	57.8	62.2	—	41.1
0.12	53.3	57.8	—	—
0.50	52.2	80.0	82.2	44.4
0.75	64.1	84.8	89.1	92.4
1.00	58.9	81.1	—	—
Untreated	1.0	4.3	1.7	4.0

Laboratory tests

These were carried out during March 1959 in glass jars of 2 litres capacity, each containing thirty adult snails of comparable size. Leaves of *Malva nicaeensis* All., sprayed with different concentrations of Isolan, were used as food. The petioles of these leaves were submerged in water in order to keep them fresh. The spray was prepared from the commercial product Primin, containing 6 per cent. Isolan.

The number of "knocked-down" snails was recorded at 6 hours, 24 hours, 48 hours and 72, following the introduction of the sprayed leaves. Each concentration was tested in three replications and their mean percentages are given in Table 1.

Perhaps the most interesting feature of Table 1 is the ability of many snails to recover, after 72 hours, from their initial poison torpor caused by the consumption of leaves sprayed with lower concentrations of Isolan. It should be recalled that snails are not much affected by mere contact with Isolan, as shown by Avidov[1]. However, sprayed leaves at all concentrations were less eaten than unsprayed ones. The lower the concentration of the

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toxicant, the higher the amount of leaf material consumed by the snails. Thus, the unsprayed leaves were devoured down to their veins. On the other hand, the higher concentrations of Isolan acted, to some extent, as repellents. The habit of snails to feign death, as distinct from poison knock-down, was noticed, though in much smaller numbers, in the untreated jars ("24 hrs." versus 48 hrs." in Table 1). At any rate, no recovery of knocked-down snails occurred later than after 72 hours. Hence, snail mortality counts following Isolan treatment should not commence before 72 hours.

It also appears from Table 1 that, under laboratory conditions, the lowest Isolan concentration required for a favourable kill is 0.75 per cent. of active ingredient. Earlier feeding-trials revealed that when offered three kinds of bran, the snails preferred wheat bran to barley or oat bran. Moist bran was consumed more readily than dry bran or any kind.

Field trials

These were carried out during April 1959 at Gan Soreq (Coastal Plain) on grazing lands. The dominant plants on these lands were *Polygonum equisetiforme* S. *et* S. (*Polygonaceae*) and *Hippocrepis multisiliquosa* L. (*Leguminosae*). The density of the snail population in those fields of calcareous soil was sometimes more than 500 adult specimens per 1 square metre.

The size of each trial-plot was 1 sq.m. Each treatment was applied in four replications distributed at random. Spraying was done by means of a hand sprayer at a rate of 50 cc. per 1 sq.m. The bait was evenly broadcast by hand at a rate of 12 grs. per sq.m. The whole set of trials was repeated twice with a ten-day interval. The treatments tested were as follows:

1. 0.5 per cent. Isolan spray.
2. 1.0 per cent. Isolan spray.
3. Dry bait, composed of 95 per cent. wheat bran plus 5 per cent. metaldehyde.
4. Moist bait, composed of 95 per cent. wheat bran plus 5 per cent. metaldehyde plus an equal weight of water.
5. Moist bait, composed of 95 per cent. wheat bran plus 5 per cent. metaldehyde plus an equal weight of a 1 per cent. aqueous solution of Isolan.
6. Moist bait, composed of wheat bran plus an equal weight of water in which Isolan has been dispersed at a rate of 1 per cent. of the entire mixture.
7. No treatment.

TABLE 2

Mean percentage kill in field trials

Treatment	Total No. of snails	Dead snails	Mortality %
1. 0.5% Isolan spray	904	841	93.0
2. 1.0% Isolan spray	1562	1363	87.3
3. Bran-metaldehyde bait dry	1487	1238	83.3
4. Bran-metaldehyde bait, moist	1937	1745	90.1
5. Bran-metaldehyde-Isolan bait, moist	2111	1888	89.4
6. Bran-Isolan bait, moist	584	165	28.2
7. No treatment	1063	47	4.4

Four days after treatment all the snails of each of the twenty-eight plots were collected and counted. The number of dead specimens prior to treatment was negligible, since this was an area of recent invasion. Average mortality percentages for both series of experiments are presented in Table 2.

A statistical analysis of the mean values of Table 2 revealed that the differences between Treatments 1—5 on the one hand and Treatments 6—7 on the other, are highly significant. This is quite obvious. However, the differences among Treatments 1—5 themselves were found to be insignificant.

The following conclusions may, therefore be drawn from Table 2:

(*a*) Isolan spray at a concentration of 0.5 per cent active ingredient is sufficient to kill more than 90 per cent. of the snails, which is not less than the kill secured by the moist bran-metaldehyde bait.

(*b*) There is no special need to moisten the bait, as the slight — yet significant — increase in kill does not warrant the extra cost involved in broadcasting moist bait. This obviously simplifies the application of the bait, as standard fertiliser broadcasting equipment may be used; particularly when the bait is prepared in dry granular form.

(*c*) Addition of Isolan to a bran—5 per cent. metaldehyde bait did not increase the snail mortality.

(*d*) A bait containing bran and 1 per cent. Isolan only, was inefficient, killing no more than 28 per cent.

Quite surprisingly, in the laboratory test 0.5 per cent. Isolan was found to be inefficient, whereas in the field the same concentration showed best performance. It may be that in the field the snails ate more than in captivity, thereby admitting higher absolute amounts of poison into their bodies.

It should also be borne in mind that the rate of spray in our field tests was no more than 500 litres per hectare, which is rather low for the normal-volume spraying equipment. There is, therefore, room for decreasing the percentage of toxicant to a level much below the 0.5 per cent. limit, if the volume of spray per area-unit is increased accordingly. Practical recommendations should preferably be given in terms of units of active ingredient

per unit of area. In this particular case: 2.5 litres Isolan per hectare of a field crop covering the entire area. It is our belief that even this dosage can still be decreased, but further field tests are required.

The white garden snail in Israel appears to be more resistant to Isolan than the European brown snail in California, in spite of the fact that the former is about half the size of the latter (shell diameters 15 and 30mm., respectively). An Isolan spray of 0.07 per cent. killed 95 per cent brown snails in California[6], whereas in our experiments seven times that concentration was needed to obtain the same mortality in the white snail. It should however be admitted that the total volume of spray used in California was about four times higher than ours. On the other hand, a bait of bran and 1 per cent. Isolan killed 88.5 per cent. brown snails[6], while exactly the same bait, broadcast at the same rate, killed only 28.2 per cent. of the white snails. This rather corroborates our view that the European brown snail is more susceptible to Isolan than the white garden snail.

It should however be stressed that the mammalian toxicity of Isolan is more than forty times greater than that of metaldehyde. Extreme caution should therefore be taken in using this pesticide.

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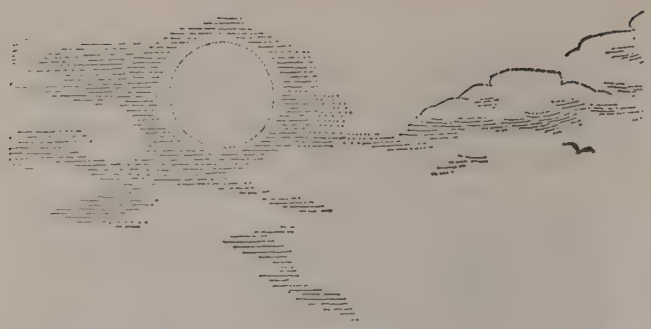

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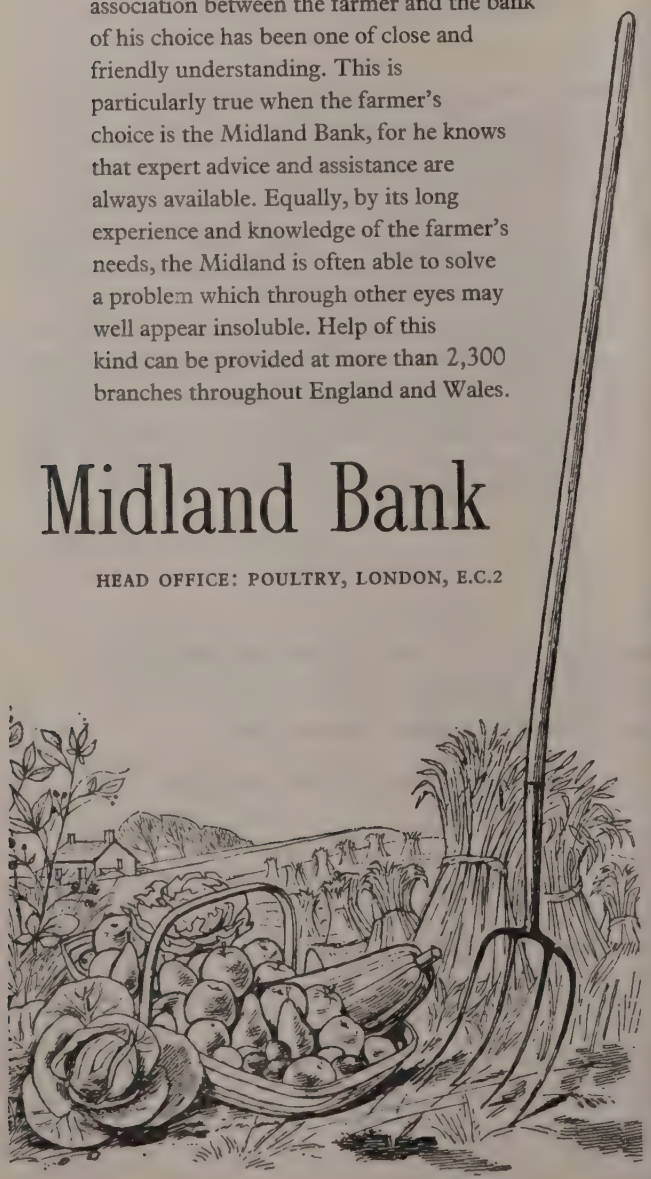

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New 30-gallon sprayer at Smithfield Show

EMPHASIS in the exhibits at the Smithfield Show next month of the Dorman Sprayer Co. Ltd., of Cambridge, will be on band spraying techniques, particularly in relation to weed control in sugar beet crops, says an announcement by the company.

Highlight of the stand will be the company's new 30-gallon sugar beet band sprayer with front-mounted tank and lances, designed for the Stanhay or Webb five-row precision drill. The complete machine consists of:

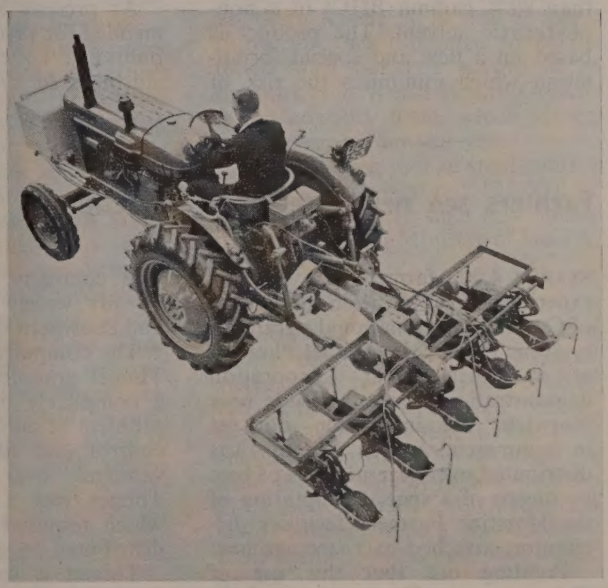
1. A 30-gallon tank with front-mounted brackets, suitable for most popular tractors, galvanised inside and out and supplied with close fitting anti-splash lid.
2. Control unit, incorporating on-off control within easy reach of the operator, pressure reducing valve, pressure regulating valve and two pressure gauges for accurate setting.
3. Distributor unit for distribution of liquids to each lance from the control unit.
4. Five adjustable lances fitted with the Dorman sugar beet nozzle. These nozzles can be supplied in three sizes, designed for 2, 2½ or 3 m.p.h. drilling rates.

Dorman say that this machine is designed principally for the application of Murbetex, but it is also suitable for band spraying Metasystox, Simazine and other products.

The sprayer can be supplied in units, if required, to enable the customer to use his own pump and filter, at a reduced price. The lances, distributor and control unit can be supplied separately, and in this way the customer may be able to modify his own existing equipment.

Another recently-introduced item of Dorman plant to be shown at Smithfield is the Spot-O-Matic boom, designed for the control of noxious weeds in grassland.

Other plant which will be featured includes the established Dorman sugar beet mounted band sprayer, which can easily be converted for ground crop spraying on corn or grass, etc.



The Dorman 30-gallon sugar beet band sprayer which will be seen at the Smithfield Show in December.

Fowl pest campaign goes into action

BECAUSE the results of last year's fowl pest campaign proved so satisfactory, the National Farmers Union national committee concerned with the problem has decided on a new campaign for this year, and this went into operation on September 1st.

Outbreaks of the trouble tend to increase at this time of the year, and it is hoped that the campaign will help to alert poultry keepers and others to the dangers of spreading infection.

One feature of the drive will be the Ministry of Agriculture's *Do's and Dont's* leaflet, which has recently been revised and redesigned. Some 300,000 poultry keepers will receive a copy. Special posters and labels are being distributed. A bulletin is to be issued at the beginning of each month giving a progress report for the previous month. These will also include new special precautions necessary for different classes of stock.

The MAFF is separately conducting a campaign designed to promote proper handling and processing of swill, as raw swill is a possible source of fowl pest infection. Local authority associations have been asked to step up their precautions, to lessen risks from spread of infection from refuse dumps and other possible sources.

Special assistance is to be given to areas where the disease appears to be gaining ground, and particular emphasis will be given to the eastern counties of England where there have been serious outbreaks in recent years.

MAFF figures quoted by the N.F.U. show that during the first eight months of the campaign between October 1960 and May 1961 the total number of outbreaks was nearly half the number recorded for the same period in the previous year; the total number of birds that had to be slaughtered was also some 50 per cent less. During June and July of this year, however, outbreaks have been higher than in the corresponding period last year.

New lindane cereal seed dressing

A NEW LIQUID seed dressing formulation has been developed which is said to be particularly effective against wireworm and, at the same time, to minimise the risk to wild life. This is Kotol, a special liquid formulation developed by Shell Chemical Co. after a period of research, extensive field trials and tests.

Kotol contains lindane (not less than 99% gamma BHC) in a non-phytotoxic solvent. The product is based on a new and special formulation which minimises the risk of phytotoxicity with which BHC has always been associated in the past. A red dye is incorporated in the product to make for easy recognition of the treated seed. Kotol should be applied in spring and autumn in conjunction with Panogen, says a statement issued by Shell. Panogen treated seed, in common with other seed dressed with mercury, is harmless to wild life.

At present Kotol is not recommended for protection against wheat bulb fly. To control this pest the aldrin-based dressing Astex should be used with Panogen on winter wheat. The seed must be well drilled and spillage on the ground should be avoided to prevent any risk to birds. This risk is also reduced by using the product only in the autumn or early winter and not in the spring.

With the introduction of Kotol, Shell's revised dressing recommendations will be as follows: (1) where there is no soil insect problem, Panogen only for protection against seed-borne diseases; (2) where there is wireworm, Panogen plus Kotol; (3) where there is a wheat bulb fly problem in autumn and early winter, Panogen plus Astex.

Farmers see new insecticide in action

NEARLY 4,000 farmers saw the first experimental application in Britain of Cyanamid International's granular systemic insecticide, Thimet Phorate, at a British Sugar Corporation demonstration recently held near Norwich. The insecticide—not yet in commercial use in Britain—was distributed over several acres of beet by means of a special adaptation of the Horstine Farmery fertiliser distributor, attached to a steerage hoe.

Pointing out that this use of Thimet was still experimental in Britain, Cyanamid explained that a number of trials were currently being held in this country with a view to introducing the insecticide later when clearance was obtained. The company say that Thimet is already widely used in the U.S.A. and elsewhere.

The company said that the use of Thimet granules on sugar beet was a completely new approach to the problem of aphid and Virus Yellows control and held considerable advantages over existing methods. Thimet was a granular insecticide which required no water, and was distributed in one application only.

Thimet is said to have a triple action: it is absorbed systemically both through roots and leaves and has a fumigant effect on application, the combined result being that one application could control aphid infestations for four weeks or longer. Field trials are reported to have shown that the use of Thimet at rates varying between 15 and 30 lb. per acre could increase sugar beet yields by some 30 per cent.

New Australian method of storing grain

SUCCESS with a new method of storing grain in bulk is reported from Australia following experiments by the N.S.W. Grain Elevators Board.

The method is said to consist of storing the wheat in flat stacks instead of in conventional silos. According to *Newsletter*, published by Cyanamid International, the grain is sprayed with malathion as it enters the stacks.

The trial involved spraying more than 250,000 bushels of the new season's wheat. An initial sampling was conducted after three months of storage and no insects were found on the surface or to a depth of 15 feet.

Spraying vehicle

MERCEDES-BENZ (GB) LTD. have announced that their versatile multi-purpose tractor vehicle, the Unimog, is now available in Britain, and was recently given its first demonstration in this country.

The vehicle can be used, with its various attachments, on heavy construction work as well as on all kinds of agricultural work, forestry and other heavy duties.

In pest control work, a number of accessories and attachments are available: swirl-atomisers, spray guns, spraying boom, etc. All equipment, including a large water tank, is carried on a loading platform and can provide misting, spraying, sprinkling, dusting or other methods.

The apparatus is driven by the rear power take-off shaft, an auxiliary secondary drive to a rear power take-off shaft or by a belt pulley.

On ordinary roads the vehicle has a top speed of more than 30 m.p.h., and can reportedly climb gradients of 1-in-1.6 when carrying a 25 cwt. payload. Both axles have differential locks for maximum traction when needed.

Australian campaign for pest control

THE AUSTRALIAN Minister for Primary Industry has announced plans to step up research into the control and eradication of skeleton weed. The spread of this weed in the farmlands of south-eastern Australia is causing increasing concern to farmers.

The weed has been a pest in the wheat lands of south-western New South Wales for more than thirty years, but in recent years it has spread into Victoria and South Australia.

The campaign is part of the federal government's programme involving expenditure of some £A250,000 on wheat research projects in 1961-62. The projects being financed range from soil fertility to wheat diseases such as wheat rust and root-rotting diseases, and grain storage.

Each of the five state wheat industry research committees finances its own research programme.

One of Australia's oldest pests—the rabbit—has become a renewed source of official concern in two states. In Western Australia, the state government has banned commercial rabbit breeding, and is preparing stricter regulations to control rabbits as pests. Commercial rabbit breeders are being given five years in which to recoup their outlay. In Victoria, where pet rabbits may only be kept on a limited basis, officials of the Vermin Destruction Board have found them being bred as a source of cheap meat in fifty Melbourne homes. (In New South Wales, however, a domesticated New Zealand species is being bred near Sydney for export as meat to Asia and the United States, and for the value of their fur.

The rabbit plague in Australia originated with a few imported in 1859. They spread in the next twenty years into New South Wales and South Australia, and even extended into Central and Western Australia, where specially-constructed fences failed to stem their advance at the rate of 70 miles a year. Their cost to the country's national economy in the destruction of pastures and vegetation, soil erosion and drift, and the measures taken to exterminate them, is said to be beyond calculation.

Crop protection studies at Welsh college

THE DEPARTMENTS of Agricultural Botany, Agricultural and Forest Zoology, and Biochemistry and Soil Science at the University College of North Wales, Bangor, have initiated a course in the theory and practice of the protection of crops against weeds, diseases and animal pests. The course is offered to honours graduates in chemistry or in the biological or agricultural sciences from any approved university.

The course includes instruction on the physical and chemical properties of insecticides, fungicides and herbicides, on their use in agriculture, horticulture and forestry and on the biology of selected pests, weeds and diseases.

Questions discussed include the principles of ecology and of selective toxicity, the physical and chemical properties of pesticides, the technology, the legal and insurance aspects of spraying, quarantine, disease resistance and the design and analysis of experiments.

In addition all students must present a dissertation on some aspect of crop protection. This, together with a written examination will normally lead to the degree of M.Sc. in one year.

Further information can be obtained from the Registrar, University College of North Wales, Bangor, Caerns.

Office move

COMMERCIAL PLASTICS LTD. announce that their marketing and administrative companies (including Fablon Ltd., Mondart Ltd., Iridon Ltd. and Thermalon Ltd.) are now located at Berkeley Square House, Berkeley Sq., London, W.1. Telephone number is Mayfair 8030.

Bilharzia infection

FOUR OUT OF FIVE Africans in Southern Rhodesia, as well as many Europeans, are estimated to be infected with bilharzia according to a report by a World Health Organisation advisory team, which visited the country earlier this year.

The cost each year of snail-control measures there is about £25,600, of which rather more than half comes from the Federal Ministry of Health.

N.Z. wood preservation

THE NUMBER of timber treatment plants operated in New Zealand increased by twenty-one to a total of 160 in the year ended last March, says a government report. The total amount of sawn timber treated rose from 176.8 million board feet to 214.9 million board feet. Of the total sawn timber treated in 1960-61, 155.5 million board feet was exotic timber.

Preservation company

A NEW FIRM concerned with the treatment of outbreaks of rot and woodworm is Property Preservation of 90b High Street, Reigate, Surrey (RE9 6366). The firm has announced that it now maintains an extensive free inspection service carried out by qualified and experienced staff, backed by mobile teams of timber treatment specialists to deal with all forms of rot and beetle damage.

Verminex move

VERMINEX LTD. have announced that they have now moved to larger premises and their address is now 105 Great Russell Street, London, W.C.1. Telephone number is Langham 8876.

NEW PUBLICATIONS

Insect Sounds. *By P. T. Haskell (Published by H. F. & G. Witherby Ltd., 5 Warwick Court, High Holborn, London, W.C.*1. *Price* 30*s.*).

When one thinks in general terms of sounds in the insect world, the best known example that comes to mind is the tapping of the furniture beetles *Anobium* and *Xestobium*. Yet this new book, which makes most rewarding and fascinating reading, demonstrates the enormous range of sounds produced by insects of many species, in the form of droning, whining, tapping and scraping and in a variety of ways.

This book is said to be the first of its kind in presenting an outline of present-day knowledge of insect sounds. The author describes the various mechanisms by which sounds are generated and detected, and analyses some of their typical patterns. He discusses the behaviour associated with sound production and draws attention to the wealth of exciting research problems waiting to be investigated.

He refers, for example, to studies made some twenty-five years ago with apparatus designed by means of amplifiers and other equipment to detect the larvae of the house long-horn beetle in samples of wood and in the timbers of a building. Rapid advances in the improvement of amplifiers and microphones has given a new fillip to this line of thought, and this, plus a greater knowledge of the types of insect sounds, makes it possible that a device of real value in the detection of infested timber, both in growing timber and in buildings, can be perfected.

"In several types of boring beetle infestation the very long larval life which the insect can pass tunnelling in the wood makes early detection difficult . . . . An apparatus which would detect larval activity in building timbers in an early stage would therefore be of great value, particularly as it would seem likely that the simplicity of use would encourage the making of periodical checks. The problem is partly technical and partly biological: the apparatus and the observer must be capable of distinguishing between larval feeding and locomotor noises, and also be able to recognise noises characteristic of sexes and species. This clearly entails a great deal of fundamental research at the outset into the sound emission and related behaviour of wood-boring insects. Feeding noises have already been utilised to localise infestations of larvae of the granary weevil, and once again with further technical development the method may become even more useful."

He discusses also the application of high intensity or high frequency sounds for killing insects (prohibitively expensive) and ultrasonic beams to disrupt swarms of locusts and prevent aggregation of biting-flies. A sonic-baited trap for mosquitoes was in fact tried out on a Cuban swamp more than ten years ago, consisting of a loudspeaker through which could be played the recorded female flight note of the species it was desired to attract; surrounding it was a metal grid connecting to a high voltage source, so that males in flight were attracted to the screen and electrocuted.

Termites—Their Recognition and Control. *By W. Victor Harris. (Published by Longmans, Green, 47 Grosvenor St., London, W.*1. *Price* 40*s.*).

The natural history of termites, like that of other social insects, is fascinating and complex. This book does a great deal to increase its fascination and even more to clarify complications which can easily become confusing. This is important because this new book on termites is intended primarily as a practical guide for all concerned with building, civil engineering, agriculture, forestry and pest control in tropical and sub-tropical areas.

About 1,800 different species of termites have been described. Of these about eighty are agricultural pests, whilst over 100 cause damage to building timbers, a half of them being capable of causing serious destruction. Others play the devil in forest nurseries, damage living trees or attack plastics, cables or packaging materials. In order to prevent such damage it is essential to identify the types of termite responsible and to know something about their habits and life history. The object of Victor Harris's book is to make the necessary knowledge available to farmers, foresters, architects and civil engineers. He succeeds in doing this for two reasons. First, because he is an authority on termites, able to call on thirty-four years' practical experience of them in Africa, Asia, Australia, the Caribbean and Arabia; second, because he writes clear, simple English and has the gift of lucid and logical exposition.

His book will be of value to professional entomologists and biologists as well as to laymen, and will certainly not be neglected by other termite experts. It covers termite biology and classification, the effect of termites on soil, and the damage they do to crops, trees and timber. It deals also, as the title indicates, with methods of preventing termite damage in each of these fields.

The prevention of termite damage to buildings is dealt with most fully and covers the nature of the damage which may occur, and its prevention by correct design of the structure, site poisoning with insecticides and the use of wood preservatives. Very useful systematic and geographical lists of termites causing damage to buildings are given.

Those parts of the book dealing with wood preservatives and insecticides are the least satisfactory, and will provide very little practical guidance for the average person with a termite problem. Most wood preservatives are proprietory products, which makes the author's task difficult though not insurmountable. But the statement that the value of proprietory preservatives may be assessed from the amount of active material they contain is unlikely to be of assistance to the average architect or builder. The suggestion that various official bodies be approached about preservatives is much more useful. No mention is made, however, of the British Wood Preserving Association which gives excellent non-partisan advice, and has produced standards for certain types of wood preservatives. It is an unfortunate omission.